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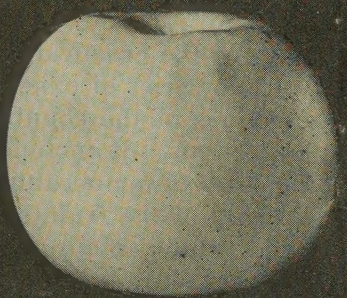
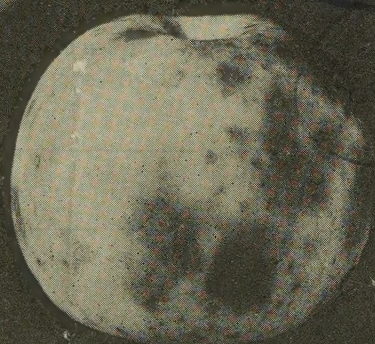
FARMERS' BULLETIN No. 1380

APPLE SCALD *and* ITS CONTROL





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SCALD is one of the most serious storage and market diseases of the apple and has an important bearing on all market operations during the latter half of the apple storage season. The disease may appear while the apples are still in storage, but it makes its most rapid development after they have been removed from storage and exposed to the warmer air of the market or the home.

This bulletin gives a summary of the practical results obtained on scald control in a series of experiments conducted in various sections of the country under commercial storage conditions. It includes the results of tests showing the effect of temperature, aeration, delayed storage, maturity of the fruit, soil moisture, oiled wrappers, oiled blotter strips, and the direct application of oils and waxes to the apples and states the relative merits of these different treatments in the control of scald.

Washington, D. C. Issued October, 1923

APPLE SCALD AND ITS CONTROL.

By CHARLES BROOKS, J. S. COOLEY, and D. F. FISHER, *Pathologists, Office of Fruit-Disease Investigations, Bureau of Plant Industry.*

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INTRODUCTION.

Scald is a storage and market disease of apples. It is familiar to the dealer and the consumer, but may be practically unknown to the grower except as it affects the returns from his crop. Scald may appear on apples while still in commercial storage, but it is only after they have been moved to the warmer temperature of the market or the home that it makes its most rapid development. Apples may appear to be in perfect condition upon removal from storage and yet a few days later have their market value reduced 15 to 30 per cent or more on account of the development of scald. A disease that makes such a sudden appearance at a time when the apples are ready for consumption naturally has a very disturbing effect upon market operations, resulting in heavy losses and tending to limit distribution and decrease consumption.

APPEARANCE AND CHARACTERISTICS OF SCALD.

In mild cases of scald the apple is merely tinted with brown, the skin remaining firm, but in more severe cases the skin tissue may be broken down to the extent that it sloughs off readily from the underlying flesh. In some instances the flesh becomes dead and brown to a depth of half an inch, and the disease takes on an appearance somewhat similar to that of apple rot; but true rot usually spreads down into the flesh in more or less conical shape, while scald affects a considerable area of the apple to a rather uniform but shallow depth. An apple that has had its skin killed by scald becomes the ready prey of the various rot organisms, and they soon finish the work of destruction that the scald has begun.

Scald differs from all other apple diseases in being more prevalent on the green side of the apple. Bright-red fruit surfaces are highly

resistant to scald, and yellow surfaces are much more resistant than those that are green or that show the first stages of turning from green to yellow.

Apple scald is a nonparasitic or physiological disease. It is not brought about by the presence of foreign organisms, but is due to certain unfavorable conditions to which the apples are sometimes subjected. Seasonal and orchard conditions are involved, as well as those that prevail in transportation, in storage, and on the market.

EFFECT OF ORCHARD CONDITIONS.

MATURITY OF THE FRUIT.

The maturity and color of the apples at picking time are very important factors in determining their susceptibility to scald, the more mature and better-colored fruit scalding less than that which is

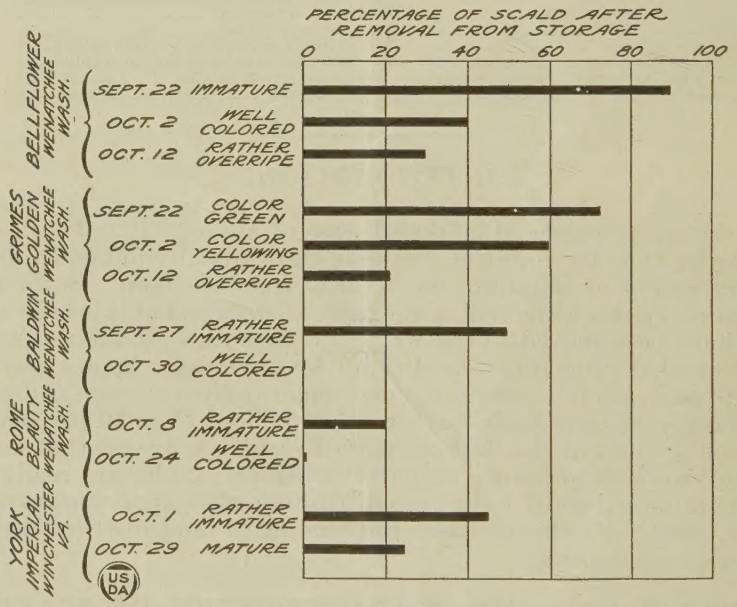

FIG. 1.—Effect of the maturity of the fruit upon the development of scald after removal from storage. Notes on the Virginia apples were taken February 25 and on the Washington apples March 12 to 19.

greener. The effect of the time of picking upon the later development of scald is brought out in Figure 1.

The results varied widely in the different tests, but in general the fruit that was well matured but not overripe developed less than half as much scald as that which was picked green.

Color and maturity are influenced by the weather conditions, the pruning, the soil, the fertilizer, and the general orchard management, as well as by the time of picking. Good exposure to sunlight produces high color and makes the apples more resistant to scald. Heavy applications of nitrogenous fertilizers make the apples more susceptible to the disease.

SOIL MOISTURE.

The effect of soil moisture upon the susceptibility of the fruit to scald can be tested most satisfactorily under irrigation conditions. Figure 2 gives the results of irrigation and storage experiments made at Wenatchee, Wash. The apples from the heavily irrigated trees developed about three times as much scald after removal from storage as those from the lightly irrigated trees. It is impossible under nonirrigated conditions to control the amount of water supplied to the soil, but it is worth while to know that apples which have been forced either by heavy rains or heavy irrigation have thereby become more susceptible to scald.

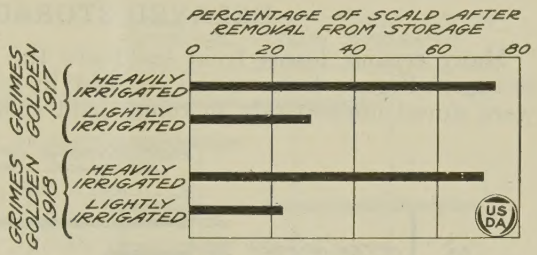

FIG. 2.—Influence of soil moisture upon the susceptibility of the fruit to apple scald.

SIZE OF THE APPLES.

In general, large apples are more susceptible to scald than small ones, but this difference in susceptibility is apparently not due so much to size in itself as to the forcing that induces the size and the immaturity and poor color that usually accompany it. Apples may develop a good size without becoming unduly susceptible to scald.

EFFECT OF PACKING-HOUSE, TRANSPORTATION, AND STORAGE CONDITIONS.

The orchard and seasonal conditions modify the susceptibility of the fruit to scald, but the conditions that prevail after the apples are picked determine the extent to which this susceptibility will be expressed in actual scald. These various conditions are considered separately under the heads of "Temperature," "Aeration and ventilation," "Humidity," etc. Although the apples are removed from the tree, they are still alive and carrying on most of their life processes. They have been cut off from their original source of food and water and must be given conditions that will conserve their stored supplies and yet allow their life functions to proceed in a normal manner.

TEMPERATURE.

Low temperature is the best means known of prolonging the life of the apple and is also a most important agency in delaying the development of scald. Figure 3 shows the results of storage experiments on eastern Grimes Golden and York Imperial at constant temperatures ranging from 32° to 50° F. An increase of 9 degrees in the storage temperature has resulted in two to three times as much scald upon removal from storage on a particular date. It will be seen from the two sets of data on the 1916 Grimes Golden that the

effect of low temperature is that of delaying scald rather than preventing it, the disease being as serious at 32° F. at the end of 16 weeks as it was at 41° F. at the end of 12 weeks.

It is important that the apples be cooled as quickly as possible after picking. They should be delivered to the storage plant promptly, and the storage conditions should be such that there will be the least possible delay in bringing the fruit to the final storage temperature. Placing large quantities of warm fruit in a single room or pile results in delayed cooling and consequent increase in scald.

DELAYED STORAGE.

Many serious losses from scald are the after effects of delayed storage. Figure 4 shows the contrast in scald between apples that were stored immediately in rooms held at 32° F. and others of the

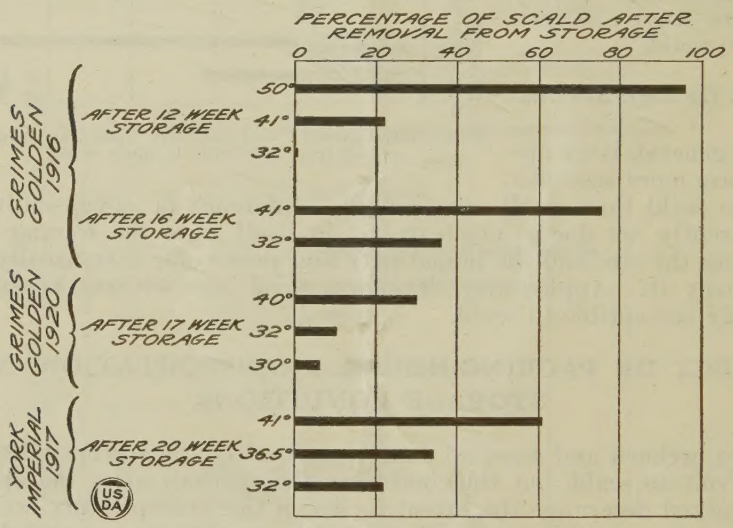

FIG. 3.—Effect of temperature upon apple scald.

same lots that were delayed in the storage hallway or at outside temperatures. It will be seen from the relative length of the bars that scald was greatly increased by the delay.

Apples that are delayed in unrefrigerated cars, in closed packing sheds, or in large stacks under any condition are almost certain to have their tendency to scald greatly increased and their storage life decidedly shortened by the treatment.

AERATION AND VENTILATION.

Free exposure to the air is often as important in scald control as low temperature, and it actually decreases the tendency of the fruit to scald instead of merely delaying the development of the disease.

AERATION DURING DELAY.

There is no other condition under which good air movement over the apples is so important as it is in cases of delayed storage. The serious damages resulting from delays at outside temperature are

shown in Figure 4, while the possibility of turning misfortune into advantage and actually reducing scald by means of aeration during the delay is shown in Figure 5. There was little or no difference in the temperatures to which the different lots of fruit were exposed, but the delayed apples in the first case were almost entirely protected from air currents while those described in Figure 5 had free exposure to the outside air. When immediate refrigeration is impossible, a great deal can be accomplished in scald control by keeping the apples in the shade and giving them the freest possible exposure

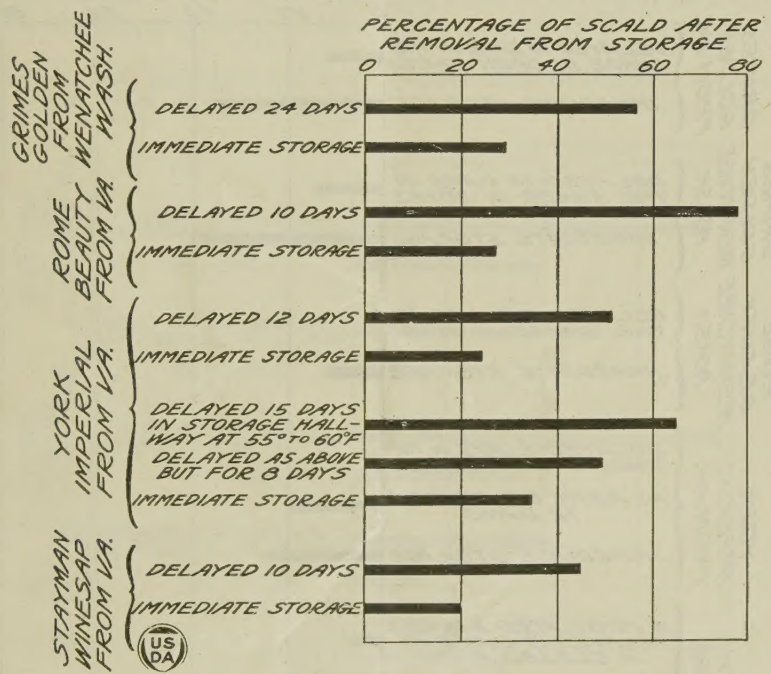

FIG. 4.—Effect of delayed cold storage upon the development of scald after removal from cold storage. The Grimes Golden apples were packed in boxes and the other varieties in barrels. The Grimes Golden and Rome Beauty were delayed in closed rooms, the Stayman Winesap and the first lot of York Imperial in a partly closed shed, and the second lot of York Imperial in the cold-storage hallway.

to the air, but it should be borne in mind that delay in cooling is always favorable to the development of rots and always shortens the life of the apple.

AERATION IN THE STORAGE PLANT.

Apples that are in the aisles or near the doors of the cold-storage rooms scald less than those that are located in the middle of the stacks (fig. 6). Whatever contributes to the openness of the storage stacks and to the freedom of air movement over the apples is of value in scald control.

Apples often scald less in the cellar and in air-cooled storage than in commercial cold storage. When this occurs the benefits of the better air movement have outweighed the harmful effects of the

higher temperatures in so far as scald is concerned. If storage cellars and air-cooled plants are tightly packed with fruit and but little attention paid to ventilation, scald is likely to be extremely bad.

It is the aeration and the ventilation given during the first six or eight weeks of storage that are of greatest value in scald control. After this time the more susceptible varieties are liable to have developed a tendency to scald that ventilation can not correct.

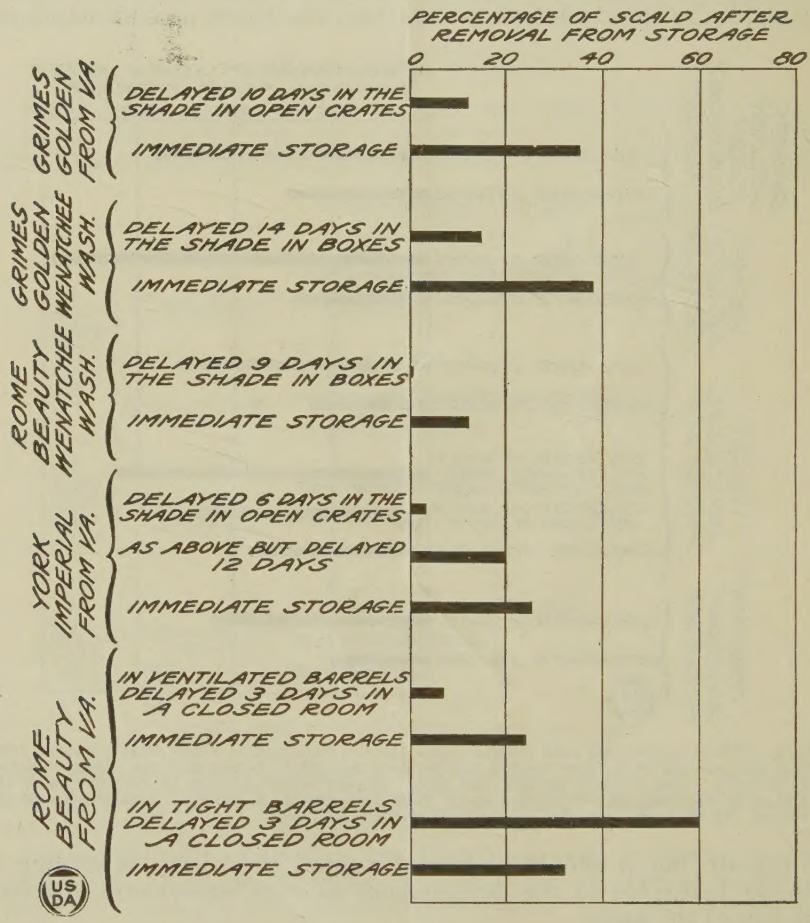
PERCENTAGE OF SCALD AFTER REMOVAL FROM STORAGE
0
20
40
60
80
GRIMES GOLDEN FROM VA.
DELAYED 10 DAYS IN THE SHADE IN OPEN CRATES
IMMEDIATE STORAGE
GRIMES GOLDEN WENATCHEE WASH.
DELAYED 14 DAYS IN THE SHADE IN BOXES
IMMEDIATE STORAGE
ROME BEAUTY WENATCHEE WASH.
DELAYED 9 DAYS IN THE SHADE IN BOXES
IMMEDIATE STORAGE
YORK IMPERIAL FROM VA.
DELAYED 6 DAYS IN THE SHADE IN OPEN CRATES
AS ABOVE BUT DELAYED 12 DAYS
IMMEDIATE STORAGE
ROME BEAUTY FROM VA.
IN VENTILATED BARRELS DELAYED 3 DAYS IN A CLOSED ROOM
IMMEDIATE STORAGE
IN TIGHT BARRELS DELAYED 3 DAYS IN A CLOSED ROOM
IMMEDIATE STORAGE
USDA

FIG. 5.—Effect of aeration during delayed storage upon the development of scald after removal from cold storage.

VENTILATED PACKAGES.

The effect of the openness of the package upon the development of scald is brought out in Figures 5, 6, 7, and 8. The tight barrels were those in ordinary use for apple packing, and the ventilated barrels differed from the tight ones in having 15 holes cut in the staves, each five-eighths of an inch wide by 4 inches long. The baskets and hampers were of the types in most common use for

apples, the baskets having overlapping slats, while the hampers had openings between the slats.

In general, there was less than half as much scald on the apples in the open packages as was found on those in the tight barrels, and with the Rhode Island Greening in hampers and the Stayman Winesap in baskets the control was decidedly better than this.

The apples in the ventilated packages cool more quickly in storage than those in the tight ones, and this in itself is of value in scald control as well as in the prevention of rots and the conservation of the life of the apple; but the greatest value of the open package so far as scald is concerned lies in the free exposure of the apples to the air.

Apples also usually scald less in boxes than in barrels, but boxes are often stacked so tightly that the value of their openness is

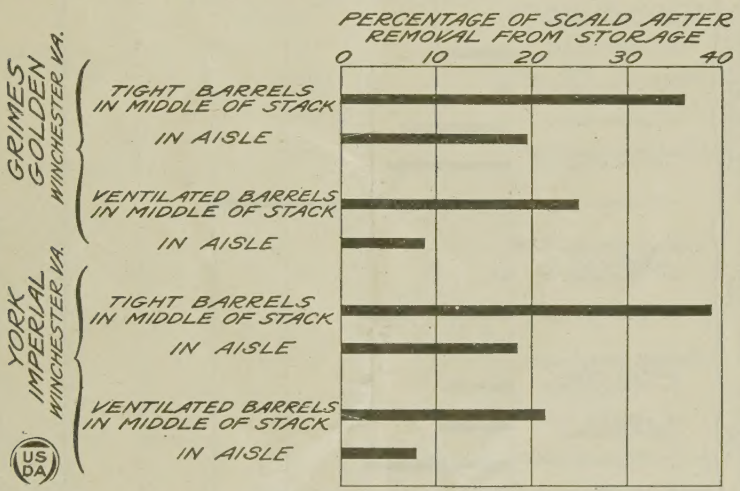

FIG. 6.—Effect of location in the storage room upon the development of scald after removal from cold storage.

largely lost, while this is a thing that can not be readily done with the hamper.

Where the work can be properly handled it is possible to decrease scald by holding apples in crates or other open packages during the first weeks of storage and then transferring them to the market package. The apples are apparently benefited both by the openness of the original containers and by the aeration received during repacking. In following this method it is essential to repack the fruit before the tissue softens, else serious losses will follow through excessive bruising and consequent increase in rot infection.

HUMIDITY.

The question naturally arises as to what the air brings to the apples or what it carries away that makes its free circulation of value in scald control. A complete and final answer to this question is not yet available, but it is known that apples scald less when dry than

when held under conditions of excessive humidity, and it seems probable that the drying and curing effect that the air has upon the skin of the apple is of value in scald control. The results of investigations, however, do not indicate that the drying effect of the air is the major factor in the control of scald, for it has been found possible to prevent the disease with good aeration even when the air was practically saturated with moisture.

ODOROUS SUBSTANCES.

It is known that the various substances that combine to produce the odor of the apple may become definitely harmful to it when

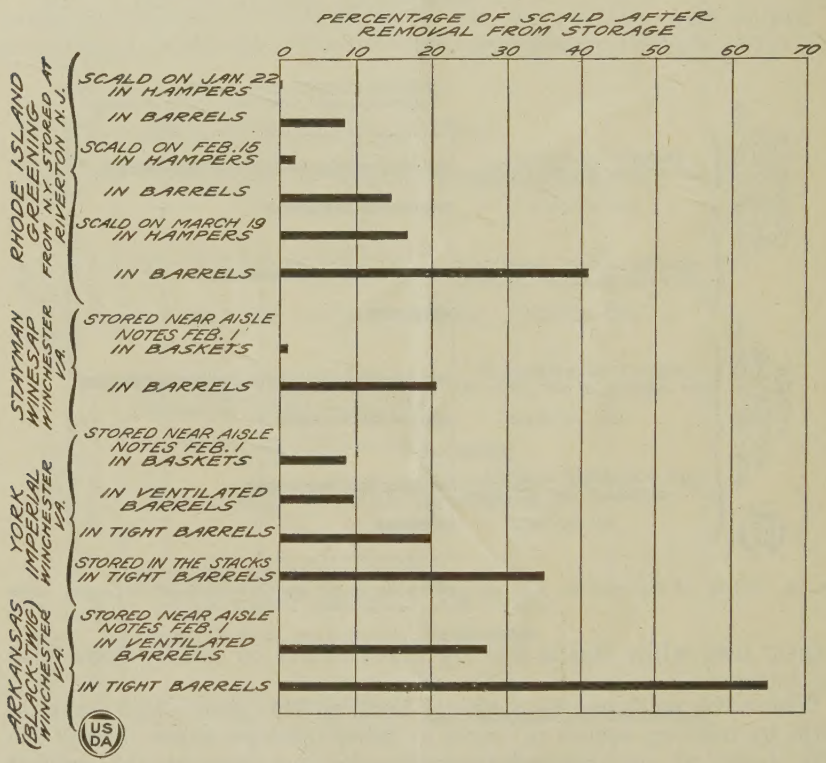

FIG. 7.—Effect of the openness of the storage package upon the development of scald after removal from cold storage.

present in great concentration and that the injuries produced are similar to scald in appearance. It seems probable that the value of aeration in scald control is at least partly due to the removal of these odorous products thrown off by the apple.

CARBON DIOXID AND OXYGEN.

It has been proved that the scald control resulting from air movement is not due to the oxygen brought to the apple nor to the carbon dioxid carried away; in fact, it has been found that high percentages of carbon dioxid delay the ripening of the apples and greatly decrease the development of scald.

OILED WRAPPERS.

A most efficient and practicable method of scald control is to be found in the use of oiled wrappers. Table 1 shows the results of tests covering five years on commercial lots of apples in the East and in the Pacific Northwest. The western apples were packed in boxes and the eastern ones in barrels. The results show the efficiency of the oiled wrapper under both box and barrel conditions, but it should be noted that it is not considered practicable to pack wrapped fruit in barrels.

TABLE 1.—*Effect of oiled wrappers on the development of scald as shown by records taken after the removal of the apples from cold storage.*

Variety and date of note taking.	Degree of scald (per cent).		Variety and date of note taking.	Degree of scald (per cent).	
	Oiled wrappers.	Unoiled wrappers or unwrapped.		Oiled wrappers.	Unoiled wrappers or unwrapped.
EASTERN APPLES.			NORTHWESTERN APPLES—continued.		
Grimes Golden:			Stayman Winesap:		
Jan. 20, 1919	0	27	Mar. 24, 1919	0	19
Jan. 13, 1920	0	83	May 23, 1921	0	16
Jan. 8, 1921	0	66	Mar. 18, 1922	.7	16
Jan. 19, 1922	0	35	May 4, 1923	0	24
Jan. 12, 1923	.1	42	Delicious:		
York Imperial:			Mar. 17, 1923	0	6
Jan. 15, 1920	0	70	Rome Beauty:		
May 14, 1921	0	89	Apr. 30, 1920	0	41
Feb. 10, 1922	2.4	8	May 18, 1921	0	30
Feb. 17, 1923	.6	31	Apr. 22, 1922	0	22
Stayman Winesap:			May 4, 1923	0	30
May 14, 1921	0	26	Arkansas (*Mammoth Black Twig*):		
Feb. 13, 1922	9.7	52	May 17, 1921	0	23
Feb. 26, 1923	7.2	22	June 7, 1922	7	17
Arkansas (*Mammoth Black Twig*):			June 6, 1923	3	45
Jan. 10, 1920	.5	38	White Pearmain:		
Feb. 24, 1921	.7	48	June 7, 1922	0	29
Feb. 21, 1923	4.6	70	Apr. 3, 1923	0	12
Rhode Island Greening:			Arkansas Black:		
Mar. 19, 1921	0	21	June 20, 1921	0	9
Mar. 29, 1922	1	28	June 14, 1922	.3	7
Yellow Newtown:			June 8, 1923	0	5
Mar. 12, 1920	0	15	Yellow Newtown:		
NORTHWESTERN APPLES.			June 14, 1922	3	33
Grimes Golden:			Winesap:		
Feb. 5, 1920	0	15	June 20, 1921	0	9
Feb. 12, 1921	0	25	June 14, 1922	0	30
Mar. 1, 1922	0	31	May 26, 1923	0	6
Feb. 17, 1923	.6	36			
York Imperial:					
Apr. 22, 1922	.4	47			
Apr. 19, 1923	.9	51			

The oiled wrappers did not completely control scald in all cases, but they held the disease in check to a remarkable degree and to an extent that materially affected the market value of the fruit. Under average market conditions 5 per cent of scald on the box apples or 10 per cent on the barrel apples would be liable to mean a discount in price, and 25 per cent of scald on the box apples or 50 per cent on the barrel apples would be likely to result in the market price being cut 25 per cent or more. It will be seen that at the time of note tak-

ing nearly all of the apples that were unwrapped or in unoiled wrappers had a much depreciated market value on account of scald, while those in oiled wrappers were either entirely free from the disease or so nearly so that their market value was but little affected. The comparative condition of the Yellow Newtown under the two methods of packing is shown in Figure 9.

Oiled wrappers were given a very thorough commercial test on the 1922 crop from the Pacific Northwest. A large number of car-lot shipments were made, and the returns from the fruit in oiled wrappers were compared with those from the fruit in unoiled wrappers. The contrast in prices increased with the advance in the season, and the results as a whole were so satisfactory that a great impetus was given to the use of oiled wrappers.

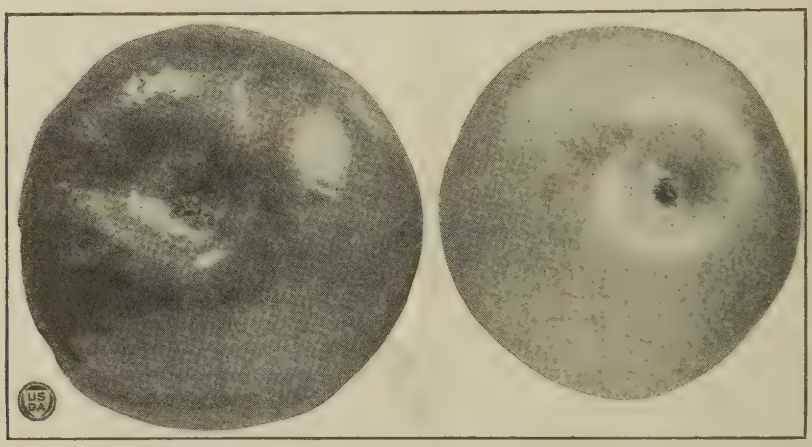

FIG. 8.—Rome Beauty apples from Vienna, Va., picked on September 27, 1918, and delayed 10 days in reaching storage. Part of the fruit was packed in tight barrels and part in ventilated ones. The scalded apple shows the condition of the fruit from the tight barrels on January 28, 1919, after removal from storage. The apple free from scald (at the right) shows the condition of the fruit in the ventilated barrels.

The oiled wrappers have also been tested on apples that were held in cellar and air-cooled storage and on others that were delayed in reaching cold storage. Under all these conditions oiled wrappers have either entirely controlled scald or greatly reduced it. The oiled wrapper has shown to a great advantage in after-storage shipments of fruit. Figure 10 shows the comparative condition of Grimes Golden in oiled and unoiled wrappers after shipment across the continent by ordinary express.

The scald control obtained with the oiled wrappers has been largely in the nature of removing the tendency to scald rather than merely delaying the development of the disease. This has been especially true with the northwestern fruit, but it has also held in the main with the eastern apples. Figure 11 shows the development of scald at various times during the storage season on eastern apples that were held in oiled wrappers and on similar apples that were unwrapped. Scald made some increase on the fruit in oiled wrappers as the season advanced, but very much less than it made on the unwrapped fruit. In all cases there was less scald on

the apples in oiled wrappers toward the end of the storage season than was found on the unwrapped fruit three months earlier.

The Arkansas (*Mammoth Black Twig*)[1] has given greater difficulty in scald control than any other variety tested. In two out of the six tests that have been combined to make the average for the variety as shown in Figure 11, the apples in oiled wrappers showed enough scald by the middle of February to affect their selling price, and by the middle of April a third of the oiled-wrapper lots had moved up to this point; but the three other lots remained practically free from scald, and the average scald for the six lots in oiled wrappers on April 15 was less than half as much as was found on the unwrapped fruit three months earlier. These results with the eastern-grown Arkansas are the poorest that have been obtained in a total of more than 80 different commercial tests with oiled wrappers.

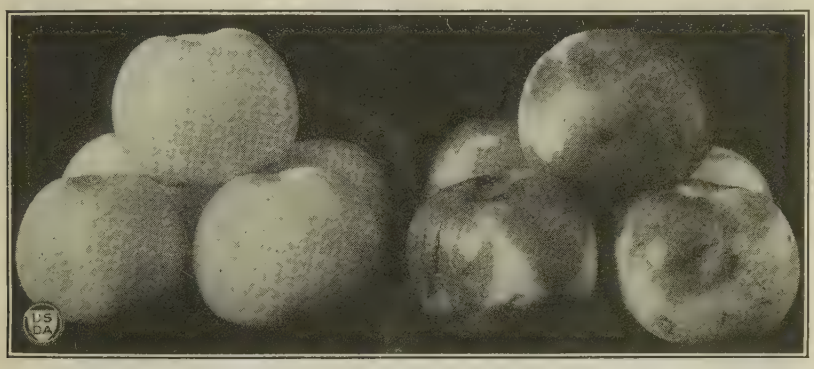

FIG. 9.—Yellow Newtown apples from Winchester, Va., picked on September 30, 1919, photographed July 1, 1920. The apples on the left were in oiled wrappers, while those on the right were unwrapped.

Paraffined wrappers have shown only about half as much efficiency in scald control as the oiled wrappers, and unoiled wrappers have had no appreciable effect upon scald.

A large number of oils have been tested on the oiled wrappers, and practically all of them have given good scald control; but the odorless, tasteless mineral oils have been found most satisfactory for use in contact with the fruit.

Wrappers carrying 5 per cent or less of their weight of oil have given poor scald control, and those carrying 10 to 12 per cent have not always given good results; but those having 15 per cent or more of their weight of oil (1 pound or more to each 1,600 to 2,000 wrappers) have been entirely satisfactory. Most of the wrappers used in the experiments here reported carried 17 to 20 per cent of oil.

The oiled wrappers used in the earlier experiments were prepared by applying oil to the ordinary apple wrappers, but those used in the later tests were from the commercial lots prepared by

[1] Some of the fruit included under the name of this variety may have been the Paragon, a variety indistinguishable from the Arkansas in the trade, very similar to it both in its habits of growth and in its keeping qualities, and so far as the writers have observed similar in its susceptibility to scald.

various paper companies to supply the demand of the apple trade. The prevailing cost of the oiled wrappers has been 1 cent to 2½ cents per box higher than the ordinary wrappers.

During the storage period some oil passes over from the wrappers to the apples, but not enough to make the fruit appear oily. The apples from oiled wrappers are normal in taste, and crisper and more attractive in appearance than those that are unwrapped or in unoiled wrappers.

The control of scald by means of oiled wrappers might seem to be in contradiction to the principles of scald control developed under the subject of aeration. It was pointed out, however, in the earlier discussion that high percentages of carbon dioxid tend to delay the

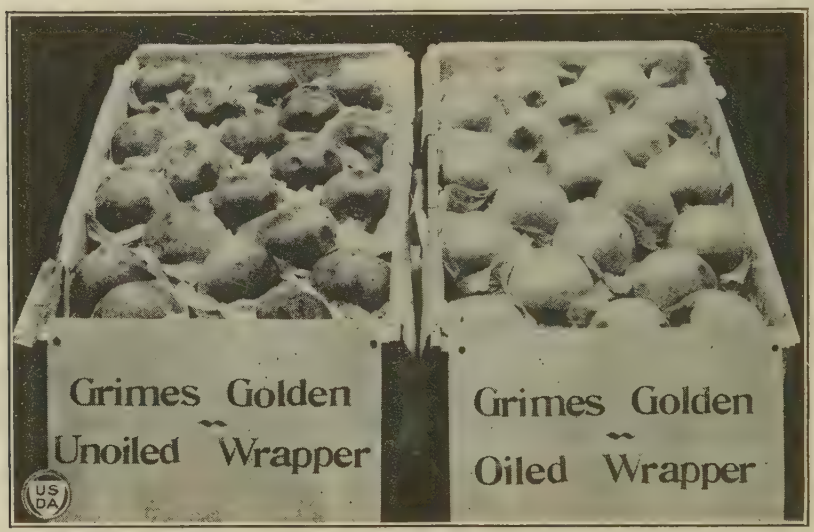

FIG. 10.—Grimes Golden apples removed from cold storage at Wenatchee, Wash., on February 13, 1923, shipped in small lot by warm express to Washington, D. C., arriving February 20; in cold storage February 21 to 26; in warm room for exhibition purposes from February 26 to March 1; photographed March 1.

ripening of the apple and to decrease scald, while high percentages of the odorous gases thrown off by the apple are injurious to the skin of the apple. The oil removes these odorous substances by absorption, in the same manner that butter and other fats take up various odors, and the oiled wrappers as they come from the package are heavily charged with the various odorous materials thrown off by the apples. The oil also has a checking effect upon the life activities of the skin of the apple, slightly delaying the development of yellow in the ground color and probably at the same time checking the development of scald.

OILS AND WAXES.

Since a large part of the apple crop goes into barrels and is not wrapped, repeated efforts have been made to find an oil or wax treatment for scald independent of the wrapper. The work has been conducted for a period of six years, and two lines of attack have been

given special attention: (1) The addition of oiled blotter and paper material to the barrel package and (2) the direct application of oils and waxes to the apples.

The blotters were cut into narrow strips, soaked with oil, and scattered between the apples at the time of packing, enough material be-

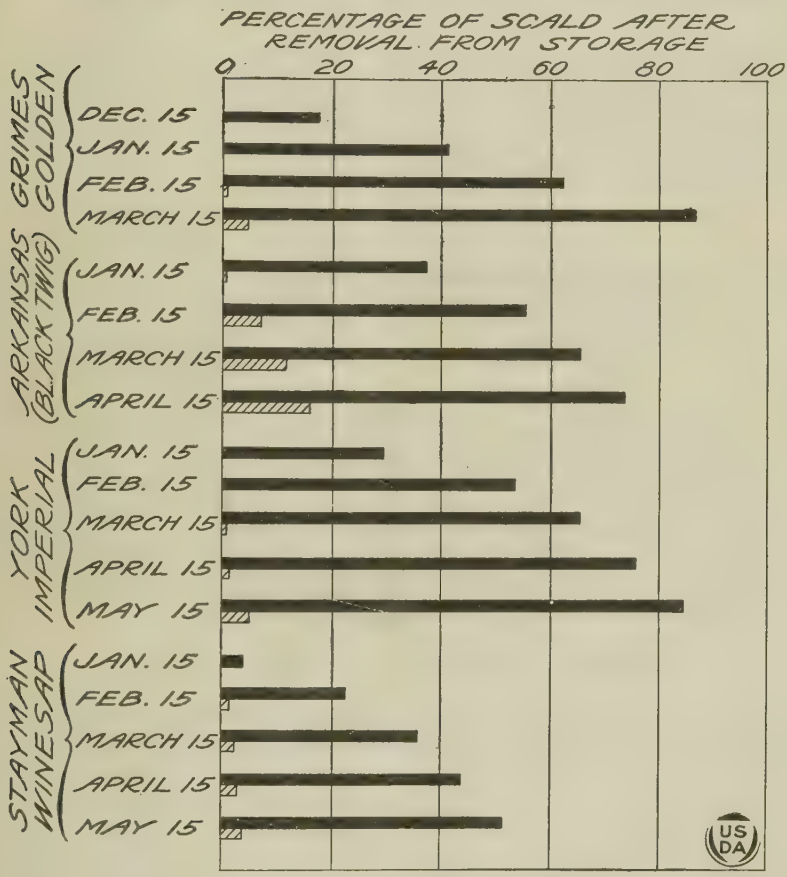

FIG. 11.—A comparison of the scald on apples in oiled wrappers with that on unwrapped apples at various times in the storage season. The results shown are the average for experiments covering five years and include tests on four different lots of Stayman Winesap, nine different lots of York Imperial, and six different lots each of Grimes Golden and Arkansas (*Mammoth Black Twig*). The degree of scald on the unwrapped fruit is indicated by the solid bar and that on the fruit in oiled wrappers by the shaded bar.

ing added to carry about 1½ pounds of oil to each barrel of apples. The treatment reduced scald on the average to about one-third the amount found on the untreated fruit, but fell far short of the results obtained with the oiled wrappers.

In the direct application of oils and waxes to the apples the material was rubbed on with a cloth in some cases, in others sprayed on with atomizers, and in still others brushed on by means of the machines used for polishing oranges. The results were very erratic, but in general the oils gave better scald control than the waxes or the

mixtures of oil and wax. The average of the results obtained with the oils on five different varieties of apples in a total of 25 separate tests is shown in Figure 12.

It will be noted that the scald control obtained with the oils was much poorer than that obtained with the oiled wrappers and that the light applications gave poorer results than the heavier ones. The oiled fruit was not attractive in appearance, because the natural bloom had been removed; the heavily oiled apples looked and felt decidedly oily and the lightly oiled ones slightly so. Injury sometimes resulted from the heavier applications of oil, and both the lightly and heavily oiled apples had more rot than the untreated fruit. The lightly oiled apples had a greener skin color than those in oiled wrappers, and the heavily oiled apples were quite objectionably green in appearance. The direct application of oils and waxes to the apples can not at present be recommended for general use.

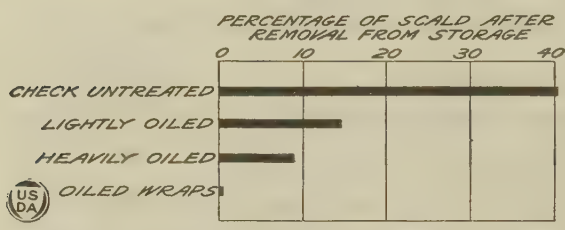

FIG. 12.—Average scald control obtained by direct applications of oil on the fruit. The heavily oiled apples received about 0.2 ounce and the lightly oiled ones about 0.05 ounce of oil to each 100 fruits.

The principles of scald control with the direct applications of oil would naturally be expected to be similar to those involved in the case of the oiled wrappers, but the checking effect upon the life activities of the apple apparently plays a relatively larger rôle in the case of the direct treatment.

CRITICAL PERIODS IN SCALD CONTROL.

The life of the stored apple may be divided into four different periods or stages with reference to the development of scald.

The first period begins with the picking of the fruit and, with the more susceptible varieties, ends with the sixth or eighth week of storage. During this time the scald-producing agencies are apparently most active, yet up to the end of the period it is possible largely or entirely to overcome any accumulated tendencies to the disease by wrapping the apples in oiled paper or by giving them a very thorough airing.

The second stage in the development of scald extends over a period of five to eight weeks following the first period. Preventive measures now become of little or no avail. The apples may be destined to scald if given sufficient time, yet if removed from storage before the end of the five to eight weeks they do not show scald even upon warming. If the apples are consumed before the end of this second period the scald problem is avoided.

The third period starts with the end of the second period and covers the remainder of the time the fruit is in storage. The apples now become latently or potentially scalded; certain skin cells are practically dead, yet they remain green and appear normal if not exposed to warm air.

The fourth period includes the life of the apple after its removal from storage and exposure to warmer air. The affected skin turns brown and completes its death processes. The apple is deprived of its protective skin layer and soon becomes the victim of apple rots.

AFTER-STORAGE BEHAVIOR OF APPLES.

If the storage rooms are opened but little and the temperature is held constantly at 32° F. apple scald may not become evident until the apples are removed from storage. Its rate of development after removal will depend upon the temperature to which the fruit is exposed. During the winter months the apples are often passed on to the consumer before the scald becomes seriously evident, but during the spring months, especially the later ones, the disease is likely to develop in transit or on the market.

In many of the experiments previously reported a record was kept of the condition of the fruit at the time of its removal from storage as well as its condition after it had become warm. The results are shown in Table 2.

TABLE 2.—*Development of scald after the removal of apples from storage.*

[The apples had not received ventilation or oiled-wrapper treatment. The eastern apples were held for 3 days at 70° F. and the northwestern apples for 7 to 10 days at 55° to 60° F. before the second inspection.]

Variety and date of removal from storage.	Degree of scald (per cent).		Variety and date of removal from storage.	Degree of scald (per cent).	
	Upon removal from storage.	After fruit had become warm.		Upon removal from storage.	After fruit had become warm.
EASTERN APPLES.			NORTHWESTERN APPLES—continued.		
Grimes Golden:			Yellow Bellflower:		
Dec. 18, 1917	0	48	Feb. 6, 1919	0	15
Jan. 12, 1923	3	42	York Imperial:		
York Imperial:			Apr. 12, 1922	12	47
Feb. 1, 1921	0	38	Apr. 6, 1923	5	51
Feb. 26, 1923	4	46	Stayman Winesap:		
Stayman Winesap:			Mar. 17, 1919	0	19
Feb. 26, 1923	2	22	May 4, 1921	4	16
Arkansas (*Mammoth Black Twig*):			Mar. 7, 1923	3	15
Feb. 24, 1921	0	48	Arkansas (*Mammoth Black Twig*):		
Feb. 17, 1923	11	75	May 4, 1921	19	23
NORTHWESTERN APPLES.			June 2, 1922	12	17
Grimes Golden:			Rome Beauty:		
Feb. 6, 1919	0	35	Mar. 17, 1919	0	11
Feb. 1, 1921	0	25	Apr. 14, 1921	2	22
Feb. 10, 1922	5	31	Winesap:		
Feb. 5, 1923	3	36	June 10, 1921	2	9
			June 10, 1922	10	30

LOSSES FROM SCALD.

Market inspection reports show apple scald as a close second to blue mold in the losses caused on the market. Since the inspections are usually made before the fruit has had much exposure to warm air and therefore before the latent scald has had a chance to become fully evident, it is probable that the total spoilage from scald is con-

siderably greater than from any other market disease of winter apples.

From the middle of December till the close of the apple season it is common in many markets to find apples offered at 10 to 40 per cent discount on account of scald. The depreciated price may be entirely due to the bad condition of the fruit at the time of sale, but it is often to be partly attributed to fear that the disease will become rapidly worse. When scald begins to appear in commercial storage lots the dealer knows that the fruit can not safely be held for more favorable prices, and it is usually moved to market and sold for what it will bring. The losses and spoilage from scald vary with the season, the city, and the abundance of the crop. More scald is evident on southern markets than on northern ones, more during warm periods than during cool ones, and more in a year when the fruit moves slowly than when there is a ready sale.

Besides the wastage of fruit and the depreciation in price resulting from scald there are general effects upon distribution and consumption that are distinct handicaps to the apple industry. The disease is a limiting factor in distribution to smaller centers and in after-storage shipments in general. The apples that are rushed through the market as scald begins to develop often become badly scalded on the hands of the consumer, not only causing him a direct loss but also preventing him from continuing as a free buyer of apples.

SUMMARY.

Susceptibility to scald varies with the season and with orchard conditions and management. Early picked and poorly colored fruit is extremely susceptible to scald, while well-colored, well-matured apples are more resistant to the disease.

Low temperature and prompt cooling are of first importance in delaying the development of scald.

Aeration is a preventive of scald, the success of the treatment varying with the thoroughness with which it can be carried out. Aeration during delayed storage is particularly important and valuable.

Storing the fruit in hampers, ventilated barrels, or baskets decreases the development of scald. Conversely, storing it in tight barrels and tight stacks favors the development of the disease.

Oiled wrappers are the most complete preventive of scald that has been found. They have eliminated the disease as a market factor in all but 2 of the 80 commercial tests that have been made.

Oiled blotter material scattered between the apples has reduced scald, but has been far less efficient in controlling the disease than the oiled wrappers.

Scald has been reduced by coating the skin of the apple with oil, but it has not been found possible to carry out the treatment without injuring the appearance of the fruit.

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Bureau of Plant Industry	WILLIAM A. TAYLOR, *Chief.*
Office of Fruit-Disease Investigations	MERTON B. WAITE, *Pathologist in Charge.*

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